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A NEW CERCARIAEUM FROM NORTH AMERICA *

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During July and August, 1915, while studying at the University of Michigan Biological Station at Douglas Lake, Michigan, rediae containing tailless cercariae were found in the livers of nine out of twenty-six specimens examined of *Planorbis campanulatus smithii* Baker. Since the adult of this species of cercaria is not known, I will place it in the provisional generic group *Cercariaeum* and give it the name *Cercariaeum mutabile*.

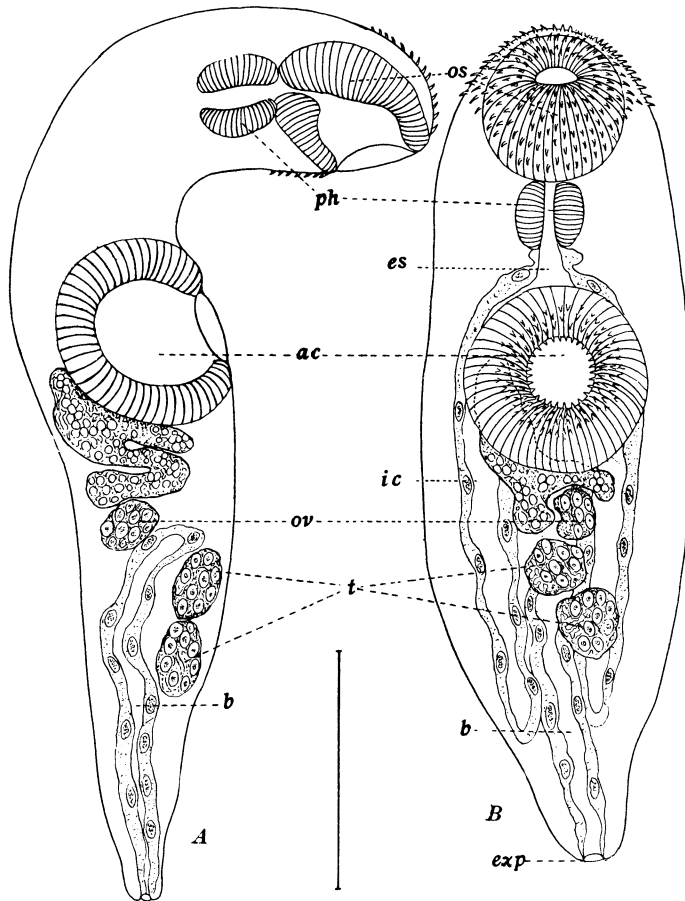
The hosts were collected from shallow water along the shore of the lake. The rediae (Figs. 1 and 2) filled the liver of the infected host and contained cercariae in all stages of development. The smaller rediae were quite mobile, altho they had no locomotor appendages. Since the rediae were without birth pores, the cercariae were obtained for study by breaking them open. The digestive sac of the redia (*ds*) is short, reaching even in the younger specimens to less than a third of the total length. The excretory system of the redia is divided into two entirely distinct halves. From the excretory pores (*exp*) short bladder tubes (*bt*) run forward which bifurcate into collecting tubes (*ct*) extending forward and backward. The anterior collecting tubes receive capillaries (*c*) from three flame cells (*f*) on each side, while the posterior collecting tubes receive the capillaries from two flame cells. The excretory system of this redia was very difficult to work out and I am not sure that all the flame cells present were located.

Cercariaeum (mutabile) (Text-figure A and B) is a large form with the adult characters well developed and almost no adaptive larval characters. No trace of a tail could be found at any stage of development of the cercaria. This cercaria is very mobile, being able to extend and contract its body to a remarkable extent. At greatest extension the body becomes so long and narrow that it resembles a nematode except for the large acetabulum which juts out prominently. When at greatest contraction the body is almost round and the acetabulum is pulled up against the oral sucker. The cercaria moves actively on a substratum by the use of its suckers, but is unable to swim.

The suckers of *Cercariaeum mutabile* are large and powerful. The acetabulum is the larger, having a ratio to the oral sucker of about three to two. The cuticular spines (Text figure B) cover a very limited area of the anterior tip. They are also found in several rows

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surrounding the opening of the acetabulum. The digestive system consists of a large muscular pharynx (*ph*), a short esophagus (*es*) and intestinal ceca (*c*), which reach almost to the posterior end of the body.



Cercariaeum mutabile

A, side view; B, ventral view; *os*, oral sucker; *ph*, pharynx; *ac*, acetabulum; *ov*, ovary; *t*, testes; *b*, excretory bladder; *es*, esophagus; *ic*, intestinal cecum; *exp*, excretory pore. Scale equals 0.1 mm.

The excretory system of *Cercariaeum mutabile* (Fig. 3) consists of a single club-shaped bladder, a complicated series of collecting tubes and sixty-four flame cells with their capillaries, arranged in eight groups of four on each side. On the left side (Fig. 3) the flame cells and their capillaries are not shown. The figure is drawn from the dorsal side and the accessory collecting tubes, the capillaries and flame cells which supply the ventral side are shown in dotted lines. The principal collecting tubes on each side divide each into two tubes, the

posterior (a') of which is much longer than the anterior. The subdivisions of these two tubes (a and a') correspond except that the relations are reversed. It can be seen that of the subdivisions of a which I have designated b and c , the one which extends posteriorly (b) does not further subdivide, while of the subdivisions of a' which are designated b' and c' it is the one which extends toward the anterior end (b') which does not again subdivide. This same relation is carried out in the third subdivision (cf , d and d' and e and e'). The capillaries from the flame cells join the accessory collecting tubes in definite groups of four, half of which are dorsal and half ventral. The flame cells are so distributed that every region of the body is drained. The extent of the subdivisions of the collecting tubes, the large number of flame cells and the definite arrangement of the capillaries into groups suggest that the excretory system of this cercaria is fully developed and represents the adult condition for the species.

The excretory system of *Allocreadium isoporum* (Looss) described by Looss (1894: 51-52, pl. 5, fig. 103) resembles in certain striking particulars the system just described for *Cercariaeum mutabile*. In *Allocreadium isoporum* the number of flame cells in each capillary group is four and the character of the bladder and the position of the main collecting tubes is the same as in my species. There are differences in the total number of capillary groups of which there are only six on each side in *Allocreadium isoporum*, and also in the arrangement of the accessory collecting tubes. The fundamental resemblances between the excretory systems of these two species must in my opinion indicate some degree of relationship.

The reproductive system of *Cercariaeum mutabile* is so far along in development that the adult arrangement of the organs can be partially made out (Text figure A). The testes (t) are located diagonally one behind the other along the longitudinal axis of the body about the middle of the post-acetabular region. They are ventral in position while the ovary (ov) which is just in front of them is near the dorsal surface. I was unable to clearly define the outlines of the other reproductive organs or to be certain of the location of the genital pore.

DISCUSSION

Since the provisional genus *Cercariaeum* is based on the single character of the absence of a tail in the fully developed cercaria within the sporocyst or redia, it is evidently not a natural group. The loss of the tail would seem to be due to the degeneration of this organ following the adoption of a type of life history in which the free swimming state is omitted. Such an adaptation might arise in any group of digenetic trematodes. Species which may be correctly placed in this provisional genus should be carefully distinguished from free

agamodistomes, which are larval distomes which have escaped from their sporocysts or redia and are waiting unencysted in secondary intermediate hosts to be carried into their final hosts. Sometimes a cercaria becomes an agamodistome in the same host which harbors its sporocyst or redia. This is the case with the so-called *Cercariaeum helici* (Leidy), found in species of genus *Helix*. Hofmann (1899) finds that the cercaria of this species develops in sporocysts in the tissues of the snail host. This cercaria, which has a very degenerate tail, escapes from the sporocyst and migrates into the kidney of the same snail where it lives as a free agamodistome until it is carried passively into its final host. Such a life history shows the free life of the cercaria reduced to a passage from one organ of the snail to another. This life history approaches the condition found in the *Cercariaeum* group in which the free stage is very probably entirely omitted from the life history.

Two species of the provisional genus *Cercariaeum*, *Cercariaeum limnaei obscuri* Ercolani and *Cercariaeum paludinae impurae* Filippi (see Lühe, 1909, 208) resemble *Cercariaeum mutabile*. Lühe (1909, 93) refers the second of these cercariae to the species *Asymphylodera tincae* and suggests that the other belongs to some *Asymphylodera* species. The structure of these forms is not fully enough described to make a detailed comparison possible. *Cercariaeum mutabile* differs from *Cercariaeum paludinae impurae* in spination, in the size of the digestive sac of the redia and in the length of the esophagus of the cercaria. Further its structure is very different from that of the members of the genus *Asymphylodera* which have only one testis and a very small round excretory bladder.

Cercariaeum mutabile in contrast with such types of larval trematodes as the schistosome or stylet cercariae shows a considerable development of adult structures and practically no adaptive larval characters. The contrast is very striking between this cercaria and such a form as the cercaria of *S. japonicum* (Cort, 1918) in which adaptations for penetration dominate the whole structure, and adult characters are practically undeveloped. Since *Cercariaeum mutabile* has no adaptations for swimming, encystment or penetration, it seems very probable that there is no free swimming period in its development, and that it must be carried passively into some final host which feeds upon the snail intermediate host.

Altho I have no direct evidence in regard to the further development of my *Cercariaeum*, structural comparisons give some clue to its relationship. As stated above the similarity of the excretory system of *Cercariaeum mutabile* to that of *Allocreadium isoporum* (Looss)

EXPLANATION OF PLATE

Cercariaeum mutabile. Scale equals 0.1 mm.

Fig. 1. Redia showing contained cercariae; *ph*, pharynx; *ds*, digestive sac; *c*, fully developed cercaria; *uc*, undeveloped cercaria.

Fig. 2. Redia showing the excretory system; *exp*, excretory pore; *bt*, bladder tube; *ct*, collecting tube; *c*, capillary; *f*, flame cell.

Fig. 3. Excretory system, dorsal view. On the right side of the figure all parts of the excretory system are shown but on the left side the capillaries and flame cells are omitted. Anterior subdivisions of the collecting tube on the left side of the figure are labeled *a-f* and the corresponding posterior subdivisions *a'-f'*. Accessory collecting tubes, capillaries and flame cells of the ventral side are shown with dotted lines. Letters as in text figure; also, *mct*, main collecting tube; *act*, accessory collecting tube.

CORT—A NEW CERCARIAEUM

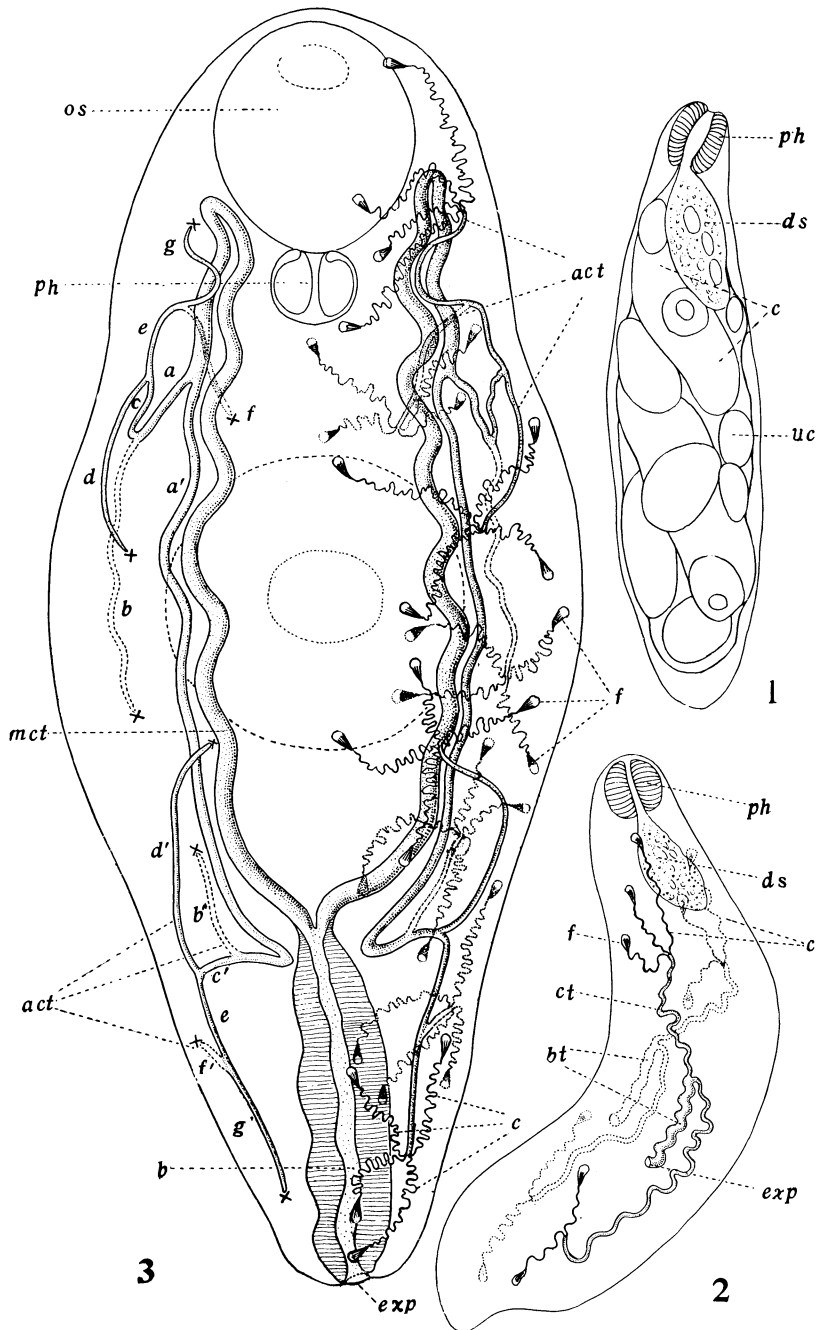


PLATE VII

seems to indicate relationship. Further, the large size of the ventral sucker of my species and the characteristics of its digestive and reproductive systems place it in the subfamily Allocreadiinae Odhner, or at least very close to this group.

SUMMARY

Cercariaeum mutabile is a new species described from *Planorbis campanulatus smithii* from Douglas Lake, Michigan.

This cercaria has practically no adaptive larval characters and a considerable development of adult characters, evidently correlated with the omission of the free swimming stage from its life history.

The excretory system consisting of a simple club-shaped bladder, a series of collecting tubes, and sixty-four flame cells with their capillaries arranged in eight groups of four on each side.

The adult of *Cercariaeum mutabile* is not known, but its structure relates it to the subfamily Allocreadiinae Odhner.

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